**How scientists will use stem cells to slow down ageing in humans**

[youtube:http://www.youtube.com/watch?v=y4k55347ik0 w auto]

Video above is about stem cell research and science of ageing, health care, life expectancy, medical advances, pensions, retirement, lifestyles.

Comment by Dr Patrick Dixon on Scottish Council on Human Bio-ethics Stem Cell Research Briefing Paper below - 2008 but many current issues:

Stem cell research continues to make rapid progress, particularly using adult stem cells from skin or bone marrow. In animal studies these adult stem cells have been treated in the laboratory and re-injected into animals that have been given artificial strokes or heart attacks. The adult stem cells automatically identify damaged tissue and produce almost perfect repairs.

Bone marrow and other tissues could repair your brain, spinal cord and heart and cure diabetes or old-age blindness. Adult stem cells promise investor returns while embryonic stem cells and therapeutic cloning raise major ethical, legal, and image problems.)

And another study has shown that bone marrow stem cells from an adult human can form healthy brain tissue.

This should not suprise us: all adult stem cells of course contain all the genetic code needed to produce an entire clone of the adult and so are well able in theory to produce whatever tissues or organs are needed.

In practice the position of a cell in the embryo determines which genes get shut down, as the fetus develops and cells become more and more specialised. It was thought that once these cells had been "determined" in the womb, they could no longer act as flexibly as embryo stem cells from which they were originally derived. But we now know this is incorrect. It is just a question of creating the right chemical bath.

The lazy way to do that (cheating) is to place the adult cell nucleus inside a human egg and let the contents of the egg (hardly understood) do it all for you. The result is a human clone with all the associated ethical problems whether you destroy it or let it be born.

The clever way to do it is to create exactly the right chemcial bath needed, in a test tube, and to bath adult cells in it, so they are tricked into thinking they must behave once more as embryo cells. As I say, the progress here has been breathtaking.

Of course there are no ethical objections whatever to using adult stem cells to create new tissues, unlike the tacky process of taking an adult cell, fusing it with an unfertilised egg, creating a cloned embryo, taking cells from it and throwing the rest away.

In human cloning an adult nucleus is placed into an egg and in that "natural" chemical bath all the genes are activated to produce an entire human being. Embryo stem cell researchers have been taking stem cells at the pre-implantation stage from human embryos because they believed that it was not possible to reactivate genes in adult cells.

So watch this space: embryo stem cells will I believe look increasingly last century and ethically suspect as a means of treating disease, compared to the remarkable potential of using the sick person's own cells.

## Bioethics paper by Kevin J. Dillon is below:



### Summary of the Main Points

1.

The object of this Paper is to provide an independent assessment of the Donaldson Committee's Recommendations in light of the most recent advances in stem cell research.

2.

Stem cells should be defined by their ability to renew themselves and diversify into other cell types.

3.

There are several readily accessible sources of stem cells. Strict criteria apply to the use of these sources in medical research.

4.

Stem cells have wide potential application in medicine. "Adult" stem cells have already been used in the world's first recorded case of successful gene therapy "surgery".

5.

The views expressed by the Donaldson Committee's on the limitations of "adult" stem cells are now defunct.

6.

Unlike "embryonic" stem cells, "adult" stem cells have already been used extensively in the successful treatment of a range of degenerative diseases and conditions and have outstanding development potential.

7.

The objections to the use of "adult" stem cells advanced by the National Institutes of Health in the U.S. have been overcome, according to the most up-to-date research.

8.

"Adult" stem cells have now surpassed all other sources of stem cells in terms of widespread clinical application, safety, availability and potential.

## Introduction

Following the publication of stem cell research: Medical Progress with Responsibility, the long-awaited Report of the Chief Medical Officer's Expert Advisory Group on Therapeutic Cloning (August 2000), a fierce debate has ensued over the Government's decision to "accept the Report's recommendations in full."[1]

Focusing on the first Recommendation made by the Advisory Group (otherwise known as the Donaldson Committee) that:

"Research using human embryos (whether created by in vitro fertilisation or cell nuclear replacement) to increase understanding about human disease and disorders and their cell based treatments should be permitted, subject to the controls in the Human Fertilisation and Embryology Act 1990."[2]

Serious ethical objections have been raised to the proposal to deliberately create and clone human embryos for the purpose of stem cell extraction, particularly in view of what opponents claim is a clearly defined and ethical alternative in adult stem cells.

However, the Donaldson Committee's Report clearly states that the ethical objections to the cloning of human embryos for this purpose are "outweighed by the potential benefits" of using embryonic stem cells to advance research into the treatment of degenerative diseases.

Submitted to the Department of Health as long ago as January 2000, the Report's recommendations are based on the most up-to-date scientific evidence available to the Donaldson Committee between January and December 1999, no less than nine months ago. And such is the pace of advances in the field of stem cell research, many experts, including scientists and medical doctors, have since challenged the basis for the Report's findings.

The object of this Briefing Paper, therefore, is to provide independent and informed analysis of the most up-to-date, cutting-edge stem cell research, in order to better inform those Members of the United Kingdom Parliament who intend to vote on whether to accept the Recommendations made by the Donaldson Committee.

This Paper is further intended as a resource for policy makers, members of the legal and medical professions and other interested parties who wish to keep abreast of the latest developments in the field of stem cell research. All information contained within this document has been obtained from sources freely available within the public domain.

## 1. Definition, Source and Application of Stem Cells.

### 1.1 What are Stem Cells?

The Chief Medical Officer's Advisory Group defined stem cells as "unspecialised cells which have not yet differentiated into any specific type of tissue."[3]

However, the limitations of this definition were made clear by David A. Prentice, Professor of Medical and Molecular Genetics at Indiana State University, in his testimony before the American Congress in February 2000. Dr Prentice defined stem cells as:

"...cells that can proliferate with almost unlimited potential, maintaining a pool of growing and dividing cells, with the added ability that some of the daughter cells can differentiate into specific cell types."[4]

This definition accords greater significance to the unique capacity of stem cells to constantly renew themselves, whilst maintaining an ability to adapt to the specific cell types needed by the human body. It is these unique properties that distinguish stem cells from other cell-types in terms of clinical application and that are central to the debate over the use of embryonic versus adult stem cells.

### 1.2 Sources of Stem Cells.

The human body is a stem cell "gold mine", providing an almost unlimited source of stem cells. However, the problem lies not in locating these cells, but in isolating them from their source.

With this in mind, scientists have isolated several key "ready-made" sources of stem cells, often referred to as "reservoirs". The following sources fall within this category:

Blastocysts - embryos after six days of growth.
Early embryos created by human cloning.
Fetal Tissue.
Adult or child tissue.
Adult or child cells that can be grown into stem cells.

To date, only stem cells taken from adults or children (known generically as "adult stem cells") have been used extensively and effectively in the treatment of degenerative diseases. This

definition is consistent with the one applied by the National Institutes of Health, the body appointed by President Clinton to consider the value of research using Human Pluripotent Stem Cells (HPSCs).

### 1.3 Application of Stem Cells in Clinical Medicine.

There are over 4,000 registered diseases specifically linked to genetic abnormalities, as well as a host of others which are thought to have a genetic component. Yet, although stem cells are unlikely to provide fast-track miracle cures for these conditions - and are even less likely to lead to a cure for all known human disease, as certain commentators have speculated - they are unique in their potential application to a large number of these diseases. As tiny factories that have an ability to "re-stock" themselves when required and develop a wide range of specialisms, stem cells meet the technical specifications for use in gene therapy..

Indeed, in many pioneering research projects, completed since the turn of the Millennium, scientists have demonstrated that stem cells can be used to replenish or rejuvenate damaged cells within the immune system of the human body and that damaged stem cells can miraculously repair themselves and their neighbours.

For example, in what is regarded as the first documented case of successful gene-therapy "surgery", scientists at the Necker Hospital for Sick Children in Paris succeeded in treating two infants diagnosed with Severe Combined Immunodeficiency Disease (SCID), a life-threatening degenerative disease caused by defects on the male (X) chromosome.[5] The team extracted "adult" stem cells from the children's bone marrow, manipulated the cells in the laboratory to replace the damaged gene with a functioning gene, then re-injected the cells back into the bone marrow. The repaired cells then "replenished" the immune system ("re-stocked" it with healthy cells) and the children have since gone on to make a full recovery.

## 2. Criteria for the Successful Use of Stem Cells in Medical Research

The Donaldson Committee established a very strict set of criteria governing the application of stem cells in research to develop treatments for degenerative diseases. Attempting to strike a balance between the availability and potential of stem cells (from all sources) against the likelihood of their successful application in such research, the Committee specified that:

"The successful application of stem cell research would depend upon:

whether stem cells can be successfully isolated and grown in the laboratory;
whether stem cells grown in the laboratory can be influenced to turn into specific cell types;
whether stem cells that have formed particular cell types could be used to treat patients whose tissue was diseased or damaged through injury;
whether tissue grown in this way would develop normally or whether there might be risks to the patient."

Based on above criteria, the Committee reached the conclusion that so-called "transitional research" is "warranted across the whole range of possible sources of stem cells in the first instance, including embryos...", but with the proviso that the use of embryos be "...necessary for the purposes of the research..."

However, whether indeed this research is "warranted across the whole range" of sources, including human embryos, is called into question by the extensive research on the medical application of adult stem cells that has been published since the submission of the Donaldson Committee's Report In January 2000.

## 3. Stem Cells: Analysis of the Most Up-To-Date Research

The Recommendations made by the Donaldson Committee can only be judged according to the yardstick of the most recent advances in stem cell research.

### 3.1 Research Contradicting the Donaldson Committee's Findings

A comparative analysis of the Donaldson Committee's findings against the most up-to-date research (available in the public domain) on the clinical application of stem cells, reveals a significant number of anomalies. The Committee's Report makes misleading, and in some cases totally incorrect, statements about the limited potential of adult stem cells as an ethical alternative to human embryonic stem cells.[6] At this point, it is important to remember that the remit of the Donaldson Committee included the assessment of "...any alternative approaches that might be pursued to achieve the same benefits."
[7]

Consider the assertion made in Section 5 of the Report:

"Theoretically, stem cells derived from early embryos have the greatest potential to develop into most types of tissue.[..] Stem cells can be extracted from some adult tissues but their potential to develop into other kinds of tissue is also likely to be limited."[8]

Again, this statement mirrors a claim made more recently by the Institutes of Health in the United States in its Guidelines for Research Using Human Pluripotent Stem Cells. However, research published in the August editions of the Journal of Neuroscience Research and the American Journal Science, revealed that adult stem cells can now be grown into liver or nerve tissue and that human adult stem cells are of "generalised potential". It is therefore a fact that, akin to embryonic stem cells, adult stem cells are now considered by the majority of research scientists to be "pluripotent" (of almost unlimited potential).

Initially published in the April 2000 edition of the Journal Science, the account of this ground-breaking research came three months after the submission of the Donaldson Committee's Report to the Government. And without prior hindsight, the Report concluded that "(t)his is basic research which if permitted would precede, probably by many years, any possible application to treatment...", and further that:

"Most scientists consulted felt that the science was still several years away from being able to deliver many of the technical building blocks needed to make significant progress in achieving healthcare benefits."

This statement was already out-of-date on the day of the Report's publication. The above evidence makes it clear that adult stem cells are already being used extensively to save or enhance the lives of a significant number of people, whereas embryonic stem cells have yet to really "scratch the surface" in terms of clinical application.

### 3.2 Significant "Healthcare Benefits" Unique to Adult Stem Cells

Over the past year, adult stem cells have been used either exclusively or in combination with other treatments to achieve significant "healthcare benefits" for sufferers of the following conditions:

Brain Tumours
Ovarian Cancer
Solid Tumours
Multiple Myeloma
Breast Cancer
Non-Hodgkin's Lymphoma
Multiple Sclerosis
Systemic Lupus
Rheumatoid Arthritis
Anaemia
Stroke
Blindness
Immuno-deficiency.

Furthermore, the future application of adult stem cells to treatment therapies, where clinical trials have already indicated significant potential benefit, include:

Parkinsons

Alzheimers
Nerve Damage
Organ Transplantation/Growth
Blood Production
Muscle Regeneration
Diabetes/Pancreatic Disorders
Heart Valve Replacement.

Following on from the specific example given in Section 1.39, documentary evidence of the above cases of successful treatment using adult stem cells can be found in a host of Journals published by and large within the past year. To give three additional examples:

1. The March 2000 Edition of the Journal Blood reported the successful treatment of Breast Cancer using a combination of chemotherapy and adult stem cell transplantation.[10]

2. The October 1999 Edition of the Journal of Clinical Oncology reported on "Long-Term Survivors" of "Advanced Neuroblastoma" who had remained disease-free for 66 months. The scientists behind their treatment reached the conclusion that:

"The requisites for survival in such patients seem to be intensive induction chemotherapy, effective surgery, irradiation, and the use of (adult) SCT (Stem cell Transplantation).[11]

3. The July 1999 Edition of the Journal of Clinical Oncology reported on a clinical trial on patients with solid tumours using chemotherapy supported by adult stem cell transplantation. 96% of patients responded to the treatment and the use of adult stem cells was found to be both "safe" and "feasible".[12]

It should be noted that, of these three Papers, two were published several months prior to the submission of the Donaldson Committee's Report to the Government. Taken in conjunction with the extensive research documenting other successes in the clinical application of adult stem cells, there emerges a clear inconsistency between the position adopted by the Committee and the most recent advances in stem cell research. Adult stem cells, derived from the human body of both adults and children, have clearly "stolen" a considerable "march" on other sources of stem cells in terms of low-risk clinical application.

### 3.2 Further Research Confirming the Feasibility of Adult Stem Cells

The Report of the National Institutes of Health (NIH), the body charged with advising the United States Government on research using HPSC, also failed systematically to represent the considerable body of research supporting the use of adult stem cells.
However, the NIH went a step further than the Donaldson Committee in outlining several very specific reasons why it believed that "adult stem cells may have more limited potential than embryonic stem cells."[13]

Firstly, the NIH claimed that "stem cells in adults are present in only minute quantities" and are

"...difficult to isolate and purify..."

This contradicts findings published in the March 2000 Edition of the Proceedings of the National Academy of Sciences, which highlighted that adult stem cells can now be grown "billion-fold" in the laboratory. Even the NIH itself recently conceded that stem cells can be produced to provide a "virtually limitless supply".[14]

Secondly, the NIH asserted the opinion that invasive surgery would be required (removal of "a portion of the brain") in order to obtain a source of neural stem cells to treat diseases such as Parkinsons and Alzheimers.

However, this is also an outdated claim, given that the June 2000 Edition of the Journal Nature confirmed that neural stem cells can be regrown inside the brain without the need for open surgery.[15] Research published more recently in the Journal of Neuroscience Research (August 2000) has added further weight to this case confirming that bone marrow cells can now be grown into neural stem cells (brain cells), thereby eliminating the need for invasive surgery.[16]

Thirdly and finally, the NIH claimed that "stem cells for all cell and tissue types have not yet been found in the adult human."

This statement may have been true when the Report was published. However, neither can this be said of embryonic stem cells (the preferred option according to the NIH). Furthermore, the March Editions of Nature Medicine and the British Medical Journal (BMJ) reported that vital adult stem cell types, such as heart and pancreas stem cells, have been identified in animal experimentation, the traditional precursor to clinical use in humans. Further studies have also shown that stem cells can be grown into other types of cells, bone marrow cells to neural cells, for example. Again, the most current evidence contradicts the findings of the NIH.

## 4. Conclusion

The recommendations made in the Reports of the Donaldson Committee in the U.K. and the NIH in the United States respectively, on the utility of using human embryos as a source of stem cells, and further on the limitations of adult stem cells, are now completely out-dated. Based on the most recent and ground-breaking medical research using stem cells, it has become clear that "adult" stem cells have outstanding advantages in terms of immediate clinical application, safety and feasibility over all other sources of stem cells and that the objections to the use of "adult" stem cells have now been overcome. Objective analysis of the most up-to-date stem cell research has revealed the following key points:

1. Adult stem cells are already being used extensively and successfully in clinical medicine.
2. Stem cells taken from human embryos have significant problems of rejection and have limited medical application.
3. Extensive documentary evidence exists to prove that adult stem cells now meet all of the criteria set down by both the Donaldson Committee and the NIH in the U.S.

1 Government Response to the Recommendations Made in the Chief Medical Officer's Expert Group Report: "stem cell research: Medical Progress with Responsibility", Department of Health, Crown Copyright, August 2000.

2 Stem cell research: Medical Progress with Responsibility, Department of Health, Crown Copyright, August 2000.

3 Stem Cell Research: Medical Progress with Responsibility, Department of Health, Crown Copyright, August 2000.

4 Congressional Testimony of David A. Prentice, Ph.D., http://www.stemcellresearch.org/prentice. htm, February 7, 2000.

5 "Gene Therapy of Severe Combined Immunodeficiency (SCID)-X1 Disease", Science 288, 669-672, April 28 2000.

6 N.B. It is these claims that form the backbone of the case in support of the cloning of human embryos for their stem cells.

7 stem cell research: Medical Progress with Responsibility, Department of Health, Crown Copyright, August 2000.

8 stem cell research: Medical Progress with Responsibility, Department of Health, Crown Copyright, August 2000.

9 The successful treatment of Severe Combined Immuno-deficiency Disease (SCID).using adult stem cells.

10 "Autologous transplantation of ex vivo expanded bone marrow cells grown from small aliqouts after high-dose chemotherapy for breast cancer.", Blood, Vol.95 No.6, 2169-2174, March 15 2000.

11 "Long-term survivors of Advanced Neuroblastoma with MYCN amplification: a report of 19 patients surviving disease-free for more than 66 months", Journal of Clinical Oncology, Vol. 17 Issue 10, 3216-3220, October 1999.

12 "Phase 1 trial of multiple cycles of high-dose chemotherapy supported by autologous peripheral-blood stem cells.", Journal of Clinical Oncology, Vol. 17 Issue 7, 2198, July 1999.

13 Guidelines for Research Using Human Pluripotent Stem Cells, National Institutes of Health, United States Government, August 2000.

14 Proceedings of the National Academy of Sciences, 97, 3213-3218, 28 March 2000.

15 "Induction of Neurogenesis in the neocortex of mice", Nature 405, 951-955, 22 June 2000.

16 "Adult rat and human bone marrow stromal cells differentiate into neurons", Journal of Neuroscience Research, Issue 61, 364-370, August 2000.